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ERRATA IN WATSON'S THEORETICAL ASTRONOMY.

Communicated by Professor G. C. Comstock.*

Page	*Line*		*For*	*Read*
283	+ 16		n''	n'''
396	− 9		A''	A'
583	$v = 69°$	$21'$	1.7793140	1.7793135
583	69	22	1.7794862	1.7794857
592	104	48	2.1821089	2.1822089
593	108	57	2.2399235	2.2399135
601	143	24	2.9627036	2.9628036
601	143	58	2.9811226	2.9810226
601	143	59	2.9816636	2.9815636

Observations of the Transit of *Mercury*, May 9, 1891, by Professor F. Soulé, at Berkeley.

Student's Observatory, Long. West Greenwich, $8^h\ 9^m\ 2^s.36$,
. N. Latitude, 37° 52′ 22″, Berkeley, May 15, 1891.

Prof. E. S. Holden, *Director Lick Observatory:*

Dear Sir.—Yesterday afternoon I observed the first internal contact of *Mercury* with the sun's disc.

Mr. A. B. Pierce, class of '90, assisted me with the Fauth chronograph, the Howard mean time clock, the Negus sidereal chronometer and the battery and local circuits. Mr. E. P. Hilborn, '91, acted as Secretary. Mr. Joseph Le Conte, Jr., observed the transit through the three-inch alt-azimuth by Fauth & Co. Mr. Anson S. Blake, '91, observed with the two-inch finder of the equatorial removed to a stand in the open air. Messrs. Ross Morgan, '91, and L. W. Lloyd, '92, also assisted in the Observatory. I observed the transit with the 6¼-inch Fauth equatorial, objective by the late J. Byrne, of New York.

The full aperture was used and a Herschelian prism deflected about 12% of the rays to a Huyghenian eye-piece of power 125 furnished with a colored glass sun-shade. The telescope was driven by clock-work and protected by an improvised umbrella screen. The weather and seeing were good and the sun's limb steady and sharply defined in the field, with the exception of an occasional slight shimmer.

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* Director of the Washburn Observatory, Madison, Wisconsin.

The planet came upon the sun at the expected place, but I was not sure, and gave no signal on the chronograph until *Mercury*, by estimation, was ¼ or ⅓ upon the disc at $3^h\ 54^m\ 5^s.46$ plus clock correction $(+\ 12^s.83) = 3^h\ 54^m\ 18^s.29$. P. S. T.

Gave first signal for internal contact, which I afterward found too early, at $3^h\ 56^m\ 18^s.13$ corrected time.

Signalled again for internal contact at $3^h\ 56^m\ 44^s.69$ (corrected). This was at the stage of transit when the following limb of *Mercury seemed* just internally tangent to the sun's circumference, but there was a little shimmering at this moment.

After this the planet remained connected with the limb by a broad dark band which gradually narrowed as the motion proceeded inward, until at $3^h\ 57^m\ 42^s.21$, it broke, and a narrow bright rim of light intervened, leaving the planet completely surrounded by the bright disc of the sun.

I regard this last as the most positive and absolute of all the observations.

The time-records were made by a break-circuit key in my hand in the equatorial room recording upon the chronograph sheet in the transit room. The mean time HOWARD clock had been carefully rated and was checked the nights preceding and following the transit.

The longitude is from telegraphic correspondence with the Lick Observatory, as well as from the U. S. C. and G. Survey records. The latitude is from the latter and from zenith telescope observations.

I watched carefully for any evidence of twilight illumination around the planet's disc, and for any other atmospheric indications, but saw none. The face of the planet was at all times entirely black, and was invisible up to the moment of projection upon the sun's face. Occasionally terrestrial atmospheric disturbance would throw a flickering grayish cloud across the whole planet, but this was only for a moment. A very large fine sunspot, attended by four small ones, was a conspicuous object near the sun's center. A smaller one in the lower left hand of the field was also casually noticed, but seemed to have no penumbra. It was nearly round, although somewhat elongated in the direction of the sun's equator.

Yours very truly, FRANK SOULÉ.

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, BY PROFESSOR C. W. FRIEND, AT CARSON, NEVADA.

From the Nevada *Tribune*, May 11, 1891, the following paragraph is taken:

"The first and second contacts of the transit of *Mercury* were successfully observed at the Carson Observatory by C. W. FRIEND, Director of the State Weather Service, assisted by D. C. GRUNOW, of the U. S. Signal Service, on May 9th, with the 5-inch equatorial and chronograph. Time of first contact, Pacific Standard Time (obtained from star transits on May 8th and 9th), 3^h 53^m $39^s.43$; second contact, 3^h 57^m $29^s.83$."

SKETCH OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, BY A. HUNNIUS, LEAVENWORTH, KANSAS.

A sketch of the transit, as viewed by projection, was received from Mr. HUNNIUS, who was assisted by Professor W. A. EVANS. The sky was cloudy and the contacts were not seen.

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, BY PROFESSOR KEEP, AT MILLS COLLEGE, CALIFORNIA.

The transit of *Mercury*, May 9, 1891, was observed at the Mills College Observatory, with the five-inch refracting telescope. The air was very clear and the phenomenon was distinctly seen by a number of observers. The planet stood out as a small black sphere, clear and sharp, while nearer the center of the sun's disc was a well defined spot, with nucleus and penumbra. The spot appeared larger than *Mercury*, but the distinction between the black disc of the planet and the hazy and irregular outline of the sun-spot was very marked. JOSIAH KEEP.

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, AT MOUNT HAMILTON, BY EDWARD S. HOLDEN AND JAMES E. KEELER.

Instruments.

The 36-inch equatorial was used with its full aperture, and a polarizing eye-piece by FAUTH & CO. The eye-piece used for the contacts magnified about 350 diameters. The field of view was quite small. The first contact was observed by Professor

KEELER with the long-finder (four inches aperture, magnifying power about 110 diameters). It was not possible to see the same part of the sun in this finder and in the 36-inch at the same time, and, accordingly, it was determined to observe the first contact with the 4-inch and the second with the 36-inch.

The ingress was to take place abont $3^h\ 54^m$, P. S. T. (8^h slower than G. M. T.), and the planet was looked for about 3^h without success. The field of the polarizing eye-piece was too full of glare for any hope of seeing *Mercury* projected on the corona.

At about $3^h\ 47^m$ Professor KEELER took his place at the 4-inch and endeavored to see the planet before ingress, without success. The air was very unsteady. (Wt. = 1.) The first contact was noted at $11^h\ 14^m\ 44^s$, Chron. 1720 = $3^h\ 53^m\ 32^s.5$, P. S. T. The observers' note was "contact certainly but very little late."

The planet was immediately placed in the field of view of the 36-inch telescope, and the ingress was watched by Professor HOLDEN. There was not the slighest trace of the planet outside of the limb of the sun between contacts I and II (nor at any other time). The atmosphere was extremely unsteady, and it was determined to note a series of times, corresponding to various phases of ingress, and to select the adopted time of contact II from among them. Accordingly, it was recorded that—

II (*a*) the cusps first meet at $11^h\ 18^m\ 53^s.5$, Chron. 1720 = $3^h\ 57^m\ 41^s.3$, P. S. T.

II (*b*). The internal tangency is complete at $11^h\ 19^m\ 3^s.5$, Chron. 1720 = $3^h\ 57^m\ 51^s.3$, P. S. T.

It was not, however, found necessary to record any other times than these. The time of contact II is the second time above given. For more than an hour after ingress the planet was carefully examined by both observers on the sun's disc. The sky was cloudless, rather milky, but the images were unsteady, although considerably better than at ingress. Magnifying powers of 350 and 570 were employed. The planet was perfectly round, and in the best moments sharply terminated. The granulations of the sun's surface were fairly well seen at times, as also the details of a large sun spot. Not the slightest trace of a satellite was seen; and both observers were confident that no such body could then be on the sun's face and escape detection, unless it were exceedingly minute.

Chronometer Comparisons.

	h.	m.	s.	h.	m.	s.	
Chron. 1720,	9	59	30.0 =	2	38	30.0,	Howard Clock
" "	11	24	15.0 =	7	10	2	Dent "
" "	11	25	32.0 =	4	4	18.0,	Howard "

$H\Delta t = +0^s.75$; $\delta T = +0^s.12$. Dent. $\Delta t = -3^m\ 32^s.65$; $\delta T = -0^s.35$.

Results of Observation.

The positive results are the following times for ingress:

	h.	m.	s.	
Contact I	3	53	32.5,	P. S. T. (J. E. K.)
" II	3	57	51.3,	" (E. S. H.)

For comparison, the following data are quoted:

	h.	m.	s.	
Contact I	3	53	14.5	(J. M. S.)
" I	3	53	7.0	(E. E. B.)
" II	3	57	53.5	(J. M. S.)
" II	3	57	54.2	(E. E. B.)

REPORT ON VISUAL AND PHOTOGRAPHIC OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, AT MT. HAMILTON, PREPARED BY J. M. SCHAEBERLE.

The conditions for securing good photographs of the transit with the 40-foot horizontal photoheliograph were not favorable, because the rays from the sun passed close to the roof of the main building, even at the ingress of the planet (hour angle 4 hours). It was necessary to stop the photographic work about an hour after ingress on this account. In spite of this drawback, it was desirable to secure a number of negatives.

Accordingly, at Professor HOLDEN'S request, I put this instrument in adjustment. It is unnecessary to give in detail the various operations, as the adjustments were made in precisely the same way as described in my "Report on the Solar Eclipse of January 1, 1891." One change, however, was made. The metallic plate-holder was originally so constructed that only a square plate of a particular size (7½ by 7½ inches) could be employed, and as such plates could only be obtained on a special order, thus involving needless time and expense, a portion of the frame was cut away, so that an 8x10 plate could at once be placed in precisely the same plane as that occupied by the original square plate. This change is a decided improvement, as the plates can now be inserted, exposed and removed in two or three seconds of time; the portion of the dry-plate projecting above the plate-holder affords an easy and quick way of handling the plates.

The slit in the drop-shutter was made about half an inch in width, and the velocity during exposure was that acquired by the shutter first falling freely through a distance of about two feet before admitting the solar rays.

A trial exposure, made by Mr. BURNHAM and myself on May 8th, resulted in an excellent negative of the sun, the atmosphere being unusually steady for daylight observations.

On the morning of the 9th I repeatedly examined the place where *Mercury* was known to be, using the 6½-inch CLARK telescope for this purpose, in the hope of being able to detect the planet, but the search was fruitless. Towards noon the sun's image was as unsteady as we usually see it here in the daytime in a clear sky.

When first seen with the 6½-inch telescope (aperture reduced to three inches) the planet had already made a slight indentation in the sun's limb, so that I was, of course, several seconds late. I waited a few seconds to make sure that the phenomenon, which, according to the predicted time, was about one minute early, was not due to the bad condition of the seeing, and then gave the signal to Mr. BURNHAM, who was within the photographic house, to make the first exposure. I observed the second contact with the same equatorial, but, owing to the low power (65 diameters) used and the bad seeing, the time of this contact may be several seconds in error.

The work from this time on was chiefly with the photoheliograph. With this instrument thirteen exposures were made. Mr. S. W. BURNHAM manipulated the plates and shutter. Mr. A. J. BURNHAM was stationed at the heliostat, and kept the sun's image properly centered; the chronometer times of exposure were recorded by myself; these times were also automatically recorded on the chronograph, using Clock No. 4; the correction to this clock being found by interpolation from two sets of time observations, one made on the night of May 8th by myself, the other on May 9th by Mr. KEELER.

Four of the thirteen negatives secured during the transit were doubly exposed near the lower edge of the sun's image, owing to the rebound of the shutter. As, however, the image of the planet does not fall within the doubly exposed segment, these plates are still available for exact measurements. On some of the plates the distortion of the planet's disc, and the serrations in the limb of the sun, plainly show the effects of the atmospheric disturbances, aggravated, no doubt, by the hot air rising from the metallic roof, above which the solar rays, forming the image, passed.

The Pacific Standard Times of Contact, as observed by me are as follows:

1st Contact $3^h\ 53^m\ 14^s.5$. Certainly several seconds late.
2d Contact $3^h\ 57^m\ 53^s.5$. May be several seconds in error, either way.

The Pacific Standard Times of Exposure of the Photographs taken with the 40-foot telescope are given in the following table:

Negatives of the Transit of Mercury.

Plate.	P. S. T. of Exposure. h. m. s.	Remarks.
1	3 53 22.1	Slight trace of indentation. Lower part of sun's image doubly exposed.
2	3 56 0.6	A very decided notch. Lower part of sun's image doubly exposed.
3	4 8 43.8	
4	(4 19 23.6)	Times doubtful.
5	(4 20 46.7)	Times doubtful.
6	(4 25 23.8)	Times doubtful. Lower part of sun's image doubly exposed.
7	4 27 35.6	Lower part of sun's image doubly exposed.
8	4 40 56.6	
9	4 48 20.1	
10	4 54 56.6	
11	5 6 11.0	
12	5 9 41.7	
13	5 13 36.7	

For Plates 4, 5 and 6 the chronometer times were not noted, and as there are several false records on the chronograph sheet, the ones selected may be erroneous.

For reducing these photographs the following constants, which were determined near the date of the transit, will be necessary.

Azimuth of the optical axis passing through the middle vertical line (the line nearest to, and on the east side of the plumb line) of the glass reticule in the focus of the 40-foot telescope. $= + 22''.3$

Altitude of the upper edge of the letter *B* in the word *OBS* engraved on the same reticule. $= + 14''.0$

Sum of the two jaw-micrometer readings at 55° Fah. being the sum of the distances from the ends of the measuring-rod to the nearest glass surfaces. $= 12^{\text{in.}}.65$

The interpolated values of the meteorological constants for the time of transit are approximately, Bar. $25^{\text{in.}}.84$, Att. Ther. 63°, External Ther. 61°.

The plates were developed by Mr. S. W. BURNHAM a day or two after the transit.

MOUNT HAMILTON, May 27, 1891.

OBSERVATIONS OF THE CONTACTS, DIAMETER AND POSITION OF *MERCURY*, AT THE TRANSIT OF MAY 9, 1891, AT MT. HAMILTON, BY E. E. BARNARD.

The transit of *Mercury* was observed with the 12-inch equatorial of the Lick Observatory. Though the day was perfectly clear, the atmosphere was very unsteady.

At the request of Professor HOLDEN I have prepared the observations for the *Publications* of the Astronomical Society of the Pacific.

After experimenting with various apertures the 12-inch was cut down to four inches, as with larger apertures the dark glass became uncomfortably heated.

Near the time of first contact *Mercury* was repeatedly and carefully looked for with magnifying powers of 150 and 175. For this purpose a very thin dark glass was used, which cut off the glare of the sky without unduly obstructing the view—the sun being kept just without the edge of the field. Up to four or five minutes before first contact no trace of the planet was visible. A darker glass was then substituted, and a further watch kept at the point of contact. A small section of the sun's limb was cut off with the micrometer wire at the position angle predicted by Professor SCHAEBERLE (*Pub.* A. S. P., vol. III, p. 67). The planet was caught sharply at the predicted point. It was seen for two seconds before the notch was certain; the time was then recorded as $3^h\ 46^m\ 34^s.7$, as the contact was visible two seconds earlier than this (as counted by the ticks of a telegraph sounder), I have subtracted two seconds from the above as the time of first contact.

For the second contact; at $3^h\ 51^m\ 7^s$, I recorded: "Not quite separate." The moment of second contact ($3^h\ 51^m\ 19^s.9$), was quite decided, there not being over one or two seconds of uncertainty. At $3^h\ 51^m\ 29^s$ "clearly separate" was recorded. I made also an estimate of the time when the planet was half on the sun; this was at $3^h\ 48^m\ 34^s$, and is quite uncertain, from the unsteadiness of the air. Following are the adopted times of contacts:

First contact, 1891, May 9th, $3^h\ 46^m\ 32^s.7$, Mt. Hamilton, M. T.
Second " " " $3^h\ 51^m\ 19^s.9$, " " "

Only that portion of *Mercury* projected on the sun could be seen. No trace of an atmospheric ring was visible, neither during the entrance on to the sun nor while in transit. No white spot (sometimes reported at transit), could be seen, the planet appearing uniformly black. The *black drop* was not present at second contact. An unsuccessful search for a satellite was made.

Mr. BURNHAM made some successful photographs with the 12-inch during the transit, the micrometer being removed and the aperture reduced to one inch. These show the planet well, as also several sun-spots, the umbra of one of which measured 18″.

As the transit afforded an opportunity for the accurate determination of the diameter of the planet, I decided to make a series of measures.

It was proposed to measure the diameter by making the edges of the wires externally and internally tangent to the disc of *Mercury*.

Practically, however, from the agitated condition of the air, it was found best to bisect the limbs with the middle of the wires, which could be done quite accurately. The measures were all double distances, and the eyes were kept parallel to the equator.

From these measures I have determined the following values for the apparent diameter of *Mercury*. They are corrected for refraction:

Mount Hamilton, M. T.

1891, May 9th, $4^h\ 50^m$	Polar Diameter,	$10''.80 \pm 0''.07$	22 observations.
	Equatorial Diameter,	$10''.83 \pm 0''.05$	22 observations.

"Polar" in this case refers to the diameter perpendicular to the celestial equator, and "equatorial" to a diameter at right-angles to that. Though the equatorial diameter comes out slightly the larger, I should not consider it necessarily due to any polar compression. These were measured with powers of 150-175-500.

Reduced to distance unity, these values become:

Polar = 6″.01 ± 0″.04.
Equatorial = 6″.02 ± 0″.03.

It was my intention to make a series of measures of the differences of right ascension and declination of *Mercury* and the limb of the sun, but the field of view was not sufficiently large to permit this being done with any degree of accuracy. I therefore made direct measures between the nearest limbs of *Mercury* and the sun. The wires were carefully adjusted to appear perpendicular to the line joining *Mercury* and the sun's limb. The position angle of the point measured from was deduced from the readings of the position circle at the time of observation. From the nature of the case the position angles given may be as much as a degree in error, which will have no sensible effect upon the measured distances. To the values thus obtained I have added 5″.4, the semi-diameter of *Mercury* deduced from my measures. These give:

Mount Hamilton, M. T.

1891, May 9th,	$5^h\ 3^m\ 24^s$	Δ = 2′ 26″.5	(4. obs.)	p = 133°.6
" "	5 42 48	Δ = 3 7 .0	(4. obs.)	p = 144 .0
" "	6 1 31	Δ = 3 15 .8	(3. obs.)	p = 149 .4

which are the apparent distances between the center of *Mercury* and the point on the sun's limb whose position angle is p. These are corrected for refraction.

During the observations the seeing ranged from 1 to 3 on a scale of 5 for perfect seeing.

In a recent article on the diameter of *Mercury* (*Astronomische Nachrichten*, No. 3034) Dr. L. AMBRONN, of Strassburg, has given a valuable table of the measures of the planet which have been made by different astronomers.

I copy this table here, and have added to it my own measures, to complete the list. The values for the diameter are all reduced to distance unity:

DOUBLE IMAGE MICROMETER.

(*During Transit.*)

No.	Year.	Astronomer.	Diam. Mercury.
1	1832	Bessel	6″.679
2	1868	Wolf	6 .229
3	1868	Plummer	6 .07
4	1868	Copeland	6 .644
5	1878	Todd	6 .604
6	1878	Schur and Hartwig	6 .802
		(*On the Sky.*)	
7	1865	Kaiser	6 .606
8	1890	Ambronn	6 .597

FILAR MICROMETER OR OTHER MEANS.

(*During Transit.*)

No.	Year.	Astronomer.	Diam. Mercury.
9	1848	Hind	6″.268
10	1861	Schmidt	6 .877
11	1861	Hartnup	6 .83
12	1868	Maclear	5 .65
13	1868	Börgen	6 .48
14	1878	Krueger	6 .205
15	1878	Bruhns	5 .900
16	1878	Peter	5 .968
17	1878	J. G. Lohse	6 .467
18	1878	Copeland	5 .961
19	1878	Carpenter	6 .942
20	1878	Maxwell Hall	6 .537
21	1891	Barnard	6 .015
		(*On the Sky.*)	
22	1882	De Ball	7 .456

E. E. BARNARD.

MOUNT HAMILTON, June 1, 1891.

NOTE ON THE VISIBILITY OF *MERCURY* DURING TRANSIT.

On the day of transit, Mr. BURCKHALTER, of the Chabot Observatory, made some interesting experiments in regard to the visibility of the planet.

He found that it could be distinctly seen with a small telescope, or one-barreled opera glass, with a magnifying power of 2½ diameters (O. G. = 1.38 in. focus 5 in.).

I have not seen elsewhere anything in regard to this subject and was always under the impression that a somewhat larger power was required to see the planet.

As *Mercury* was wholly invisible to the unaided eye on May 9, I have thought that some further experiments in this same line might be of interest, in determining how small a magnifying power would really show the planet.

The experiments were made with a glass positive from one of Mr. BURNHAM'S negatives of the transit made with the 12-inch. Perhaps this method is better than to use a black spot on white paper to represent the planet.

With this projected against the bright sky, *Mercury* was just visible with the eye at 96 inches, while the limit of visibility with Mr. BURCKHALTER'S glass (kindly loaned for the purpose) was 246 inches.

The image of the sun on the positive was 1.7 inches. At 183 inches this would subtend the same angle as the sun in the sky.

Assuming the conditions the same, it is evident that *Mercury* could not be seen in transit with the naked eye, but it appears that a power of two diameters should just show it. It was actually seen by Mr. BURCKHALTER with 2½ diameters.

On this photograph is shown a considerable sun-spot. This was visible at a distance of 25 feet. It would appear that the spot should have been visible to the naked eye, though I did not so see it on the 9th. Measurements at the time of transit made the diameter of its somewhat irregular umbra = 18″ and the penumbra 34″.

E. E. B.

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, BY CHARLES BURCKHALTER, OAKLAND, CAL.

CHABOT OBSERVATORY, OAKLAND, May 9, 1891.

I observed the transit of *Mercury* with the full aperture of the 8-inch equatorial, using the power of 150 and a HERSCHEL prism. The following times are given in Standard Pacific Time, the longitude of the Observatory being $8^h\ 9^m\ 6^s.62$ W. from Greenwich, as telegraphically determined by the U. S. C. and G. S.:

	h.	m.	s.	
Time of 1st contact,	3	53	19.5.	Seeing first-class.
Time of 2d contact,	3	57	59.9.	Seeing good.

I saw no evidence, whatever, of "black drops," excepting about thirty seconds before second contact, when the sun's limb was boiling badly, when it was seen for a few seconds—in fact—during the time of greatest disturbance.

I obtained my time by transit observations of stars on the nights of May 8th and 9th.

I availed myself of this opportunity to determine, as near as possible, the lowest optical aid required to see the planet on the sun's disc. I have a small telescope with $1\frac{4}{10}$-inch objective and 3.2 inches focal length, giving a power of (as near as I can determine) two and one-half diameters. This was attached to the finder of the 8-inch equatorial, the driving-clock of which greatly assisted in bringing out its full power. I was assisted by three young men from the Oakland High School, who had had some little experience in observing.

When the planet was well on the sun's disc, each one made an effort to find it with the small telescope, but, as they were ignorant of the planet's position, and did not know whether the telescope was inverting or not, they all failed to find it, although each one found the sun-spot near the planet. After cautioning them to look for *Mercury* near the limb of the sun, and giving them the position—*i. e.*, *the quadrant*—in which he would be found, Messrs. Taylor and Young found the planet, and correctly drew his position, while Mr. Guppy failed entirely, even with a diagram before him, giving the planet's position.

I saw it myself, distinctly, but a knowledge of its position, no doubt, materially aided me, and would certainly not have seen it without very close scrutiny. Charles Burckhalter.

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891,
BY W. C. PARMLEY, OGDEN, UTAH.

Office of W. C. Parmley, City Engineer and
Building Inspector, Ogden, Utah, May 12, 1891.

I made some observations of the transit of *Mercury* on the 9th and, though they may not be accurate enough to be of much use to you, I will send them.

I observed with a $1\frac{7}{8}$-inch telescope of 45 diameters magnifying power; Mr. Bostaph, my assistant, with an engineer's transit, 1-inch glass and 25 diameters magnifying power.

My time was taken from the Western Union time signals, as they came from Washington, at 10 o'clock. My watch on the

11th was only one second different from what it was on the 9th, so I did not apply any rate correction.

I computed the exterior ingress contact; and the interior contact I obtained by adding the difference given in the Ephemeris.

Computed times, as well as those observed, are as follows:

	Exterior.			Interior.		
	h.	m.	s.	h.	m.	s,
Computed,	4	54	21.2	4	59	16.9
PARMLEY,		54	14.0		59	06.0
BOSTAPH,		54	14.0		59	04.0

In computing I used the latitude and longitude for Ogden given in the Ephemeris, though my place of observation was one and one-quarter miles east of the old observatory.

I expect to compute and observe the eclipse of June 6th, and will send the results, if they have any value.

W. C. PARMLEY.

P. S. (May 21.)—I have triangulated carefully the distances from the Latitude and Longitude Observatory Pier to the City Hall, and the distances are as follows to where my telescope was—6394 feet east and 69 feet north. These measures are probably correct within three feet. Mr. BOSTAPH was stationed about eight feet south of me. I find the marks on the pier slightly different from the values given in the Ephemeris. They are: Longitude 111° 59′ 54″.64; latitude 41° 13′ 08″.56. I do not know the cause of the difference.

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, BY C. W. IRISH, RENO, NEVADA.

RENO, May 16, 1891.

PROF. E. S. HOLDEN: I have duly received yours of the 13th inst., and as you state your intention to publish my report of observations of the partial transit of *Mercury* made by myself on the 9th inst., by the aid of Mrs. IRISH as time-reader, I deem it best to rewrite said report and condense it as much as I can.

First contact came on while the sun's limb was very much agitated by puffs of cold air, coming from a southwest direction, and the first sign I saw of the planet was at $3^h\ 54^m\ 00^s.031$, and I had, one and one-half seconds before this, been looking at the exact point of contact, but, owing to the remoteness of the sun's limb, did not see the planet. So I place the latter time at

$3^h\ 53^m\ 58^s.531 \pm 0^s.3$, and believe that had it not have been for the agitation of the sun's limb I should have seen *Mercury* then, if not in contact, certainly about in that position. The notch, made at the former time, flashed, as it were, into sight upon a partial cessation of quivering in the air.

At $3^h\ 55^m\ 08^s.67$ could distinctly see the whole of *Mercury's* disc, at which time, I judged it about bisected by the sun's limb.

At $3^h\ 56^m\ 25^s.905$ I judged the limbs of the sun and *Mercury* accurately tangent. (2d contact.)

At $3^h\ 57^m\ 15^s.65$ saw what I took to be a line of light between the limbs, but as I afterwards saw what I took to be a very delicate line of light encircling the planet's disc, it may have been this which I saw at this time.

At $3^h\ 57^m\ 27^s.77$ certainly saw the cusps of sunlight meet around the planet's disc, and,

At $3^h\ 58^m\ 06^s.$ saw the planet fully upon the sun's disc with as much as 2″ space between limbs.

The air was very clear, no clouds being in sight; the only thing in the way of very accurate observations was the disturbance of the sun's limb by puffs of cold air, and they were intermittent.

I saw a copper-red, trapezoidal spot on the planet's disc, and could make out at intervals the encircling line of light before spoken of.

I saw that the planet's disc was not black, but had a grayish hue, it appearing of a lighter gray at the center. The times given are 120th meridian time, taken from the telegraphic signals sent out from the Lick Observatory on the 8th, 9th and 11th instants.

Very respectfully,

CHAS. W. IRISH, *Civil Engineer.*

(See page 242.)

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, BY WILLIAM S. MOSES, SAN FRANCISCO.

[Mr. MOSES kindly sent to the Lick Observatory a letter describing his observations together with a drawing of the phenomena showing two phases at ingress and the position of the planet at 5 and 6 P. M. The following abstract gives the necessary data.]

Place of Observation: Masonic Cemetery, San Francisco; the latitude and longitude are given by Mr. MOSES on the authority of Mr. WM. M. PIERSON, as follows:

North Latitude	37° 46′ 15″.
West Longitude . . .	122° 26′ 30″.

Instrument: 7½-inch Reflector made by J. A. BRASHEAR, of Allegheny.

Observer: WILLIAM S. MOSES.

Watch-Correction: One-third second slow, as determined by Mr. F. H. MCCONNELL, by comparison with his clock, which is daily compared with the L. O. time signals.

The time-signals require the further correction $+ 0^s.75$ hence the watch-correction was $+ 1^s.08$, which has been applied.

Observations: The sun's image was projected on white paper inside of a dark box so as to be 5⅝ inches in diameter. The first notch in the limb was noted at $3^h\ 54^m\ 29^s$, and the second phase noted was when a ring of light (about one-fifth of the diameter of the planet in the sketch) had been formed, at $3^h\ 58^m\ 26^s$. These times require the correction above given. Drawings of the various groups of sun-spots are given also. The first contact was well seen; the second phase was not so satisfactorily observed.

OBSERVATIONS OF THE TRANSIT OF *MERCURY*, MAY 9, 1891, BY WILLIAM M. PIERSON, SAN FRANCISCO, CAL.

I observed the 1st and 2d contacts of *Mercury's* transit to-day. My observatory is in—

Latitude	37° 47′ 39″.52 N.
Longitude . . .	122° 25′ 19″.99 W.

Observation made with 8½-inch reflector equatorially mounted. Power used 25.

Clock set to P. S. time obtained from F. H. MCCONNELL at 2 P. M. [This requires the further correction of $+ 0^s.75$.]

Observation made on bristol-board screen 18 inches from eye-piece.

From $3^h\ 50^m$ until after second contact limb of sun very unsteady but at moments definition good.

First contact, limb unsteady, time $3^h\ 54^m\ 22^s + 0^s.75$.

Until planet half on disc it presented the appearance of parallelogram projected at right angles to the sun's limb. From that time to second contact disc of planet of normal shape.

Second contact $3^h\ 57^m\ 42^s + 0^s.75$. Limb very unsteady and I suspected that that was cause of second contact occurring apparently earlier than predicted, but within five seconds afterwards the definition was momentarily good and could perceive line of light between planet and limb. Unless this was effect of planet's atmosphere the second contact occurred at the time above given.

A fine sun-spot, about 10′ from planet at ingress, lent interest to the phenomenon. Wm. M. Pierson.

Observations of the Transit of *Mercury*, May 10, 1891, by Prof. T. C. George, University of the Pacific, College Park.

[From a note by Professor George, the following data are taken.]

Place of Observation: Observatory of the University of the Pacific, whose latitude and longitude are—

North Latitude . . .	$37^\circ\ 20'\ 46''.3$
West Longitude . . .	$8^h\ 7^m\ 35^s.15$

Instrument: Six-inch equatorial by Alvan Clark, magnifying power, 140 diameters.

Observer: T. C. George.

Watch-Correction: Derived from L. O. time signals (which require the correction $+0^s.75$, which has been applied).

Contacts:	First Contact . . .	$3^h\ 53^m\ 5^s.8$ P. s. t.
	Second Contact . .	$3^h\ 58^m\ 0^s.8$ P. s. t.

The definition was good.

Who Discovered the Optical Property of Lenses?

[Notes by Dr. J. L. E. Dreyer, Director of the Observatory of Armagh, and by Professor Schiaparelli, Director of the Observatory of Milan.]

[Our members will recollect a question raised by Professor Hanks, and treated at some length in *Publications* A. S. P., vol. III, No. 15, page 133. It has received a solution in a private letter from Dr. Dreyer dated May 15, 1891, lately received at the Lick Observatory, as follows:]

"I read yesterday, with much interest, No. 15 of the *Publications* A. S. P. I am happy to be able to tell you who HOSTIUS was, though I am afraid you will be disappointed when you become acquainted with him, for he was a most atrocious ruffian! You will find all about him in SENECA'S *Quæstiones naturales*, lib. I, cap. xvi.

"It is enough to say that he did not use a *lens*, but merely a mirror 'specula imagines longe majores reddentia, in quibus digitus bracchii measuram et longitudine et crassitudine excederet.' He lived at the time of AUGUSTUS, and no doubt it was merely a slip that AGRIPPA quoted COELIUS instead of SENECA."

Professor SCHIAPARELLI writes as follows:

MILAN, le 18 Mai 1891.

Monsieur le Professeur et honoré Collègue:

J'ai reçu votre dernière lettre et je vous suis bien obligé pour les sentiments de bienveillance dont elle est l'expression.

En lisant dans le dernier cahier des *Publications of the A. S. of the Pacific* l'article "*Who discovered the optical properties of lenses*"*?* et la discussion sur HOSTIUS, je me suis rappelé que l'histoire de ce curieux personnage (qu'il ne faut pas confondre avec l'auteur du pöeme *De Bello Histrico*) est racontée avec assez de details dans l'Ouvrage si intéressant de Senèque, *Quaestionum Naturalium libri VIII;* cherchez livre 1, Chap. 16. HOSTIUS QUADRA vivait du temps d' Auguste et il etait fameux par ses débauches; il obtenait *à l'aide de miroirs courbes* l'amplification apparente de certains objets. Le passage de Senèque montre qu'a cette époque on connaissait l'effet des miroirs courbes non seulement pour modifier les dimensions apparentes des objets, mais aussi pour en déformer l'image à plaisir. Il n'y est point question de lentille.

Mais il parait qu'une *lentille divergente* etait employée par NÉRON (qui etait *myope*) pour voir mieux les spectacles du cirque; du moins c'est l'interprétation plus naturelle qu'on peut donner à un passage de PLINE, *Hist. Nat.* XXXVII, 5. Il est bien certain que les anciens connaissaient d'une manière empirique et approximative l'effet des lentilles et des boules de verre sur les dimensions apparentes; ils les employaient comme *verres comburants* pour concentrer les rayons du soleil et allumer le feu.

Tous les témoignages des anciens Auteurs sur cette matière ont été recueillis et discutés aver beaucoup de compétence dans le memoire suivant: H. Martin: *Sur des instruments d'optique faussement attribués aux anciens:* Rome, 1871.[*] Ce Memoire se trouve dans le Tome IV du Recueil qui a pour titre: *Bullettino di storia delle scienze matematiche e fisiche, pubblicato da* B. Boncompagni: qui est entièrement consacré à l'histoire des sciences physiques et mathématiques.

J'ai l'honneur d'être votre très devoué,

J. V. Schiaparelli.

OBSERVATIONS OF THE SOLAR ECLIPSE OF JUNE 6, 1891, AT THE LICK OBSERVATORY.

The various observations have been tabulated as below by Professor C. W. Treat.

	First Contact.	Second Contact.	Duration.	Instrument.	Magnifying Power.
	h. m. s.	*h. m. s.*	*h. m. s.*		
E. S. Holden....	6 10 18.8	7 46 51.1	1 36 32.3	$2^{in}.75$ telescope	49
J. M. Schaeberle	6 10 12.0	7 46 55.0	1 36 43.0	6-inch Equatorial reduced to 3 in.	65
E. E. Barnard...	6 10 12.2	7 46 56.3	1 36 44.1	12-inch Equatorial reduced to 4 in.	175
C. W. Treat.....	6 10 20.0	7 46 49.0	1 36 29.0	4-inch Comet seeker reduced to 2½ in.	40

The times are civil times of the 120 meridian.

OBSERVATIONS OF THE SOLAR ECLIPSE OF JUNE 6, 1891, AT THE CHABOT OBSERVATORY, BY C. BURCKHALTER.

The Second Contact was observed at 7^h 48^m $12^s.6$ P. s. t.

Charles Burckhalter.

A note from Mr. Orris Harmon, of Chehalis, Washington, says that the eclipse could not be observed at that place on account of clouds.

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[*] Dr. Drever also gives a reference to this work. It is not in the L. O. library.

Reno, Nevada, June 11th, 1891.

Prof. Edward S. Holden, *Director Lick Observatory:*

Dear Sir—I have been away from home a month, and, on my return, find yours of date May 19th awaiting me.

At the risk of being too late I answer your questions.

The approx. lat. of my station N. 39° 31′.9
" " long. of my station 119° 48′.75 G. W.

The times were taken from Mean-time Chronometer No. 602, Morris Tobias, London, regulated to Pacific Standard Time (120° Mer.), by use of the telegraphic time-signals by means of two "hack" watches at Central Pacific R. R. Office in Reno. By this means I found the rate of the chronometer as follows:

May	8th,	Telegraph	Noon	Chronometer,	slow	22.5	secs.
"	9th,	"	"	"	"	25.0	"
"	10th,	"	"	Estimated,	"	27.5	"
"	11th,	"	"	Chronometer,	"	30.0	"

This chronometer is the property of Mr. Richard Herr, watchmaker and jeweler of this place.

I am, very truly yours,
C. W. Irish, *Civil Engineer.*